11. Screening of Alternatives

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TABLES

11. SCREENING OF ALTERNATIVES

The screening of remedial alternatives for WAG 5 sites is discussed in this section. In accordance with the EPA guidance for conducting remedial investigations and feasibility studies under CERCLA (EPA 1988), each remedial alternative identified in Section 10 was evaluated against three general criteria: effectiveness, implementability, and cost. Detailed descriptions of these criteria are given in EPA guidance for conducting feasibility studies under CERCLA (EPA 1988). A general description of each screening criterion follows:

- Effectiveness—Effectiveness is the most important aspect of the screening evaluation. This criterion is used to assess the ability of an alternative to provide both short-term and long-term protection of human health and the environment. In this application, short-term refers to the implementation period (i.e., the construction phase) and long-term refers to the period thereafter. The ability to reduce the toxicity, mobility, and volume of the contaminated material also is included as a measure of effectiveness.

- Implementability—The implementability criterion is used to assess the technical and administrative feasibility of implementing an alternative. Technical feasibility includes the construction, operation, and maintenance required for implementation of the remedial action. Administrative feasibility includes regulatory and public acceptance, availability of services and specialized equipment, and personnel requirements. Short-term implementability refers to the implementation period itself (i.e., during the remedial action), and long-term implementability refers to the operation, maintenance, and institutional control period thereafter.

- Cost—The cost criterion is used to assess the relative magnitude of capital and operating costs for an alternative during the specified period of active control. Short-term cost refers to the implementation period and long-term refers to the operation, maintenance, and institutional control period thereafter.

A description of each alternative developed in Section 10 is provided below to evaluate effectiveness, implementability, and cost. These descriptions are intended to provide sufficient detail to distinguish among the alternatives relative to the three screening criteria. Each description provides general information about the technologies composing an alternative and the applicability of those technologies to the conditions at WAG 5. The following subsections provide a description of each alternative and an evaluation based on the three screening criteria. Specific assumptions for cost-estimating purposes are in Appendix K.

11.1 Remedial Alternatives for Contaminated Soils

11.1.1 Alternative 1: No Action

11.1.1.1 Description. The NCP (40 CFR 300.430 [e][6]) requires consideration of a no action alternative to serve as a baseline for evaluation of other remedial alternatives. Under the no action alternative, no land use restrictions, controls, or active remedial measures would be implemented at the site. Risk levels would be reduced only through radioactive decay or other natural processes. Environmental monitoring can be part of a no action alternative while DOE has institutional control of the INEEL, which includes the Site operational period and at least 100 years following Site closure.

Environmental monitoring would be performed to detect contaminant migration and to identify exposures from soil, air, and groundwater. Monitoring results would be used to determine the need for any future remedial actions necessary to protect human health and the environment. Monitoring would be conducted until a future review of the remedial action determined that further monitoring would not be required. Soil, air, and groundwater environmental monitoring activities would be performed under WAG- and INEEL-wide comprehensive monitoring programs to the extent practicable. Radiological surveys would be performed at sites with contaminated media remaining in place as part of this remedial action until Site-wide environmental monitoring programs are implemented. Groundwater monitoring requirements would be identified in reviews conducted every 5 years to evaluate the effectiveness of the institutional controls and the need for further environmental monitoring or additional control measures as applicable. The 5-year site reviews would be conducted for a 100-year period. Air monitoring would be conducted as part of the INEEL-wide air monitoring program.

11.1.1.2 Evaluation. The no action alternative could be implemented easily at moderate cost at all sites. However, the no action alternative is ineffective in mitigating risks and does not meet RAOs. Estimated costs for the no action alternative are provided in Table 11-1.

11.1.2 Alternative 2: Limited Action

11.1.2.1 Description. Alternative 2 consists of the following remedial actions to protect human health and the environment against potential risks associated with WAG 5 soil sites:

- Institutional controls
  - Existing soil cover integrity monitoring and maintenance
  - Surface water diversion
  - Access restrictions
  - Long-term environmental monitoring (the same as for the no action alternative).

Maintenance of surface soil integrity, including the repair of subsidence and erosion effects, would be performed as necessary to prevent surface exposure of subsurface contamination. Existing soil covers would be maintained using the same type of native soil present at WAG 5. Surface water diversion measures would be used to prevent ponding. Contour grading, drainage ditches, and other appropriate measures would be used to direct surface water away from sites of concern to natural or engineered drainage as required.

Access to the INEEL is currently restricted for security and public safety. Because WAG 5 sites are located within the boundaries of the INEEL, Site-wide access restrictions would limit accessibility for at least 100 years. In addition, existing fences surrounding WAG 5 sites would be maintained and replaced as necessary. The installation of additional fences or relocation of the existing fences also could be necessary. Other access control measures could include warning signs, assessing trespassing fines, and establishing training requirements for persons allowed access. Land-use restrictions could be specified if government control of the INEEL is not maintained throughout the institutional control period.

Table 11-1. Net present value of capital, operating and maintenance, and total costs for remedial alternatives at WAG 5 contaminated soil sites.

	Contaminated Soils Remedial Alternatives							
Description	1 No Action	2 Limited Action	3a Excavation, Consolidation, and Containment Using Native Soil Cap	3b Excavation, Consolidation, and Containment Using Engineered Barrier	4a Removal and Disposal on the INEEL	4b Removal and Disposal off the INEEL	5a Removal, Ex Situ Sorting, and Disposal on the INEEL	5b Removal, Ex Situ Sorting, and Disposal off the INEEL
FFA/CO management and oversight								
Program management	125,000	125,000	375,000	375,000	375,000	375,000	375,000	375,000
Remedial action document preparation								
Remedial design/remedial action scope of work	54,000	54,000	54,000	54,000	54,000	54,000	54,000	54,000
Remedial action work plan	63,000	63,000	63,000	63,000	63,000	63,000	63,000	63,000
Packaging, shipping, transportation documentation	NA[a]	NA	48,000	48,000	48,000	48,000	48,000	48,000
Remedial action report	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000
WAG-wide 5-year review	141,000	141,000	141,000	141,000	141,000	141,000	141,000	141,000
Remedial design document preparation								
Safety analysis documentation	100,500	100,500	100,500	100,500	100,500	100,500	100,500	100,500
Sampling and analysis plan	108,000	108,000	108,000	108,000	108,000	108,000	108,000	108,000
Pre-final inspection report	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Remedial design								
Added institutional controls—5-year review for 100 years	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000
Title design construction document package	NA	52,800	202,200	237,200	70,800	70,800	378,800	378,800
Remedial action—construction subcontract								
Site characterization	130,500	130,500	130,500	130,500	1,272,900	1,762,500	701,700	946,500

Table 11-1. (continued).

Description	1 No Action	2 Limited Action	3a Excavation, Consolidation, and Containment Using Native Soil Cap	3b Excavation, Consolidation, and Containment Using Engineered Barrier	4a Removal and Disposal on the INEEL	4b Removal and Disposal off the INEEL	5a Removal, Ex Situ Sorting, and Disposal on the INEEL	5b Removal, Ex Situ Sorting, and Disposal off the INEEL
	Contaminated Soils Remedial Alternatives							
Construction subcontract	NA	510,510	6,581,578	5,975,619	8,440,471	20,476,418	12,507,475	18,545,875
Project/construction management	NA	128,700	829,611	753,229	705,424	705,424	1,745,525	1,745,525
Total Capital Costs	**809,500**	**1,501,510**	**8,720,889**	**8,073,548**	**11,466,595**	**23,992,142**	**16,310,501**	**22,593,701**
Remedial action operations (100-year duration)								
Program management	3,385,000	3,385,000	3,385,000	3,385,000	NA	NA	NA	NA
WAG-wide 5-year review for 100 years	3,243,000	3,243,000	3,243,000	3,243,000	NA	NA	NA	NA
Added institutional controls—5-year review for 100 years	640,000	640,000	640,000	640,000	NA	NA	NA	NA
Construction, INTEC caretaker/maintenance	2,010,000	2,559,000	4,585,000	4,585,000	NA	NA	NA	NA
Operations, maintenance, materials, and disposal	NA	NA	NA	NA	NA	NA	NA	NA
Decontamination and dismantlement of facilities	NA	NA	NA	NA	NA	NA	NA	NA
Surveillance and monitoring	4,035,000	4,035,000	4,035,000	4,035,000	NA	NA	NA	NA
Total Operations Costs (100 years)	**13,313,000**	**13,862,000**	**15,888,000**	**15,888,000**	**NA**	**NA**	**NA**	**NA**
CAPITAL AND OPERATIONS COSTS SUBTOTAL	**14,122,500**	**15,363,510**	**24,608,889**	**23,961,548**	**11,466,595**	**23,992,142**	**16,310,501**	**22,593,701**
Contingency 30%	4,236,750	4,609,053	7,382,667	7,188,464	3,439,978	7,197,643	4,893,150	6,778,110
GRAND TOTAL	**18,359,250**	**19,972,563**	**31,991,556**	**31,150,012**	**14,906,573**	**31,189,785**	**21,203,651**	**29,371,811**
Total Project Costs in Net Present Value[b]	**8,186797**	**9,333,155**	**18,698,524**	**17,923,000**	**13,796,742**	**28,836,026**	**19,614,936**	**27,159,094**

a. NA = not applicable

b. The net present value is a way to calculate cost estimates that factors in inflation but allows for equal comparison of long-term and short-term alternatives.

Site inspections and maintenance of fences and surface drainage would be implemented. Monitoring and inspection results would be evaluated during 5-year reviews to determine whether active remediation is required at specific sites.

11.1.2.2 Evaluation. The limited action alternative could be implemented easily for both the short- and long-term because the specified actions are a continuation of existing management practices. Soil cover maintenance, surface water diversion, and fence maintenance would be performed only on an as-needed basis. Estimated costs for the limited action alternative are moderate. A summary of costs is provided in Table 11-1.

This alternative is effective for protecting human health during the 100-year period of institutional control. However, after institutional control of the INEEL is discontinued, risks would be the same as for the no action alternative. Risks to human health and the environment will remain at unacceptable levels after 100 years at all sites of concern. Ecological risks would not be reduced by institutional controls. Therefore, the limited action alternative is not an effective long-term remedy. This alternative is screened from further consideration for all WAG 5 soil sites of concern.

11.1.3 Alternatives 3a and 3b: Excavation, Consolidation, and Containment within WAG 5

The two containment alternatives, Alternatives 3a and 3b, consist of the following remedial actions to isolate contaminated soil at ARA-01, ARA-12, ARA-16, ARA-23, ARA-25, and PBF-16:

- Characterization
- Removal using conventional excavation techniques
- Segregation and incineration of vegetation
- Soil consolidation
- Containment with a protective cover over the consolidation site
- Site restoration at the excavation site
- Institutional controls at the consolidation site
    - Long-term environmental monitoring (the same as for the no action alternative)
    - Cover integrity monitoring and maintenance
    - Access restrictions
    - Surface water diversion.

The description of the containment alternatives is presented in four parts. Remedial actions common to both containment alternatives are described in Section 11.1.3.1. Requirements for the preparation of a foundation over the selected consolidation site before emplacement of contaminated soils and a protective cover are presented in Section 11.1.3.2. Shielding requirements for the protective cover designs are addressed in Section 11.1.3.3. Each protective cover technology and the associated screening evaluation are described in Section 11.1.3.4.

11.1.3.1 Remedial Actions Common to Alternatives 3a and 3b. Remedial actions common to both containment alternatives are described in this section. The institutional controls specified will remain in place for the 100-year institutional control period and are the same for each containment alternative. The general description of these remedial actions is, therefore, applicable to both containment alternatives.

Contaminated soil from the WAG 5 sites of concern that exceed human health and ecological PRGs, ARA-01, ARA-12, ARA-16, ARA-23, ARA-25, and PBF-16, would be excavated using conventional equipment. Standard engineering and administrative controls would be applied to limit short-term exposure to radiological hazards during the implementation of the remedial action. Soils would be characterized before excavation to minimize the volume of soil excavated. Vegetation would be segregated and sized using a wood chipper or similar type of equipment. For cost-estimating purposes, it is assumed that the chipping operation will not require a confinement structure. However, if required by safety analysis or ARARs, a small, temporary confinement building with negative pressure ventilation would be used during the chipping operation. The excavated soils would be transported and consolidated at a single hypothetical disposal site within WAG 5, such as the region around the SL-1 reactor building foundation within ARA-23. The sized vegetation would be boxed in cardboard containers and transported to the Waste Experimental Reduction Facility (WERF) incinerator for disposal. After excavation, the contaminated sites would be backfilled as necessary with clean soil, restored by contouring to the conditions of the surrounding landscape, and revegetated in accordance with INEEL revegetation guidelines (DOE-ID 1989).

Areas planned for excavation would be gridded, characterized, and excavated in discrete depth intervals. Excavation would proceed only to the depth intervals at which contamination greater than PRGs is encountered. Sampling and analysis of soils underlying clean intervals would be used to verify that all soil contaminated at levels higher than PRGs had been removed. Soils would be transferred by bulk shipment to the selected disposal site. Appropriate contamination control measures would be implemented to prevent accidental releases.

Environmental monitoring, cover integrity monitoring, access restrictions, and surface water diversion would be maintained at the consolidation site during the active institutional control period. Radiation surveys would be performed at the disposal site to detect radionuclides mobilized by burrowing animals, erosion, or other natural processes. Access restrictions and surface water diversion measures would be implemented. Permanent warning markers would be placed on and around the cover.

Monitoring and maintaining the protective cover would apply to both containment alternatives. Effective maintenance of the protective cover would be determined on the basis of cover integrity monitoring. The protective cover likely would be monitored frequently during the first 6 to 12 months because potential problems (such as settling or subsidence) are most likely to occur within this period. After the initial 12 months, cover integrity monitoring could be performed annually or semiannually. Maintenance requirements include periodic removal of undesirable vegetation and burrowing animals and filling animal burrows. In addition, unacceptable erosion or subsidence would require repair of the affected area. Maintenance would be performed on an as-needed basis. Operations and maintenance goals will be defined during the remedial design process.

11.1.3.2 Protective Cover Foundation. Preparing a stable foundation in a centralized location before the construction of a protective cover would be essential to ensure long-term integrity of the containment. The location of the foundation will be selected in an area within WAG 5 that is relatively flat and is not in a natural surface water runoff channel, such as the area around the SL-1 reactor building foundation within ARA-23. Subsidence could breach the integrity of any cover selected as a remedial action. Therefore, each containment alternative is assumed to include appropriate foundation preparation measures to prevent any differential settling that could cause subsequent failure of the proposed cover.

A centralized location among the contaminated sites would be selected for consolidation of contaminated soils. The preparation of the foundation would consist of clearing, grubbing, bulldozing, and compacting the site. Mechanical compaction would be performed concurrently with moisture addition to achieve better compaction and prevent airborne dust. Alternatively, fill material would be placed over contaminated surface soil to prevent generation of airborne contamination during vehicle compaction. The most appropriate method of foundation preparation would be determined during the remedial design phase.

11.1.3.3 Shielding Requirements. Soils and other geologic materials at the INEEL have previously been shown to readily attenuate Cs-137 dispersed in contaminated soil (LMITCO 1997). The primary measure of effectiveness for the containment alternatives is the ability to satisfy the RAO of preventing external radiation exposure. Each cover design is, therefore, evaluated for the ability to provide sufficient shielding to reduce the dose rate from the surface of the site to background levels. For this FS, shielding requirements developed for the WWP cells (LMITCO 1997) are assumed to be sufficient for all WAG 5 radiologically contaminated soils because of the much higher activities in the WWP cells than are present at any WAG 5 site. However, actual shielding requirements would be determined during the remedial design process.

11.1.3.4 Containment Alternative Descriptions. Both the containment alternatives listed in Section 10.1.3, native soil cover and engineered barrier, specify use of protective covers in a centralized location for the contaminated soil at WAG 5 sites of concern to prevent human and environmental exposure. The difference between the containment alternatives is in the design of the cover. No attempt has been made to enhance the basic design concepts of these cover technologies because of the unlimited number of variations possible. However, features from the individual cover designs may be combined in the remedial design phase to optimize containment performance. This section describes each cover technology and the associated screening evaluation for the containment alternative.

11.1.3.4.1 Alternative 3a: Excavation, Consolidation, and Containment within WAG 5 with a Native Soil Cover

11.1.3.4.1.1 Description—The native soil cover consists of a single layer of soil obtained from the INEEL, applied in lifts, and compacted to 95% of optimum moisture and density. The surface could be completed with a 3 to 5% slope and vegetated with native plants. Gravel mulch tilled into the top 6-in. (15 cm) of the cover could be used to reduce erosion and promote vegetation. Costs of gravel and native soil obtained on the INEEL are relatively similar, and incorporating a soil-gravel mixture surface would not result in a significant cost variance. A rock armor or other surface covering also could be incorporated during the remedial design process.

11.1.3.4.1.2 Evaluation—This cover would reduce radiation exposure to background levels, facilitate runoff, limit soil erosion, and inhibit human and biotic intrusion. A vegetated surface with a 3 to 5% slope would enhance runoff of precipitation without developing flow velocities that would cause erosion. Actual soil thickness would be determined during the remedial design process.

The short-term effectiveness of this alternative for protecting human health and the environment is moderate. Equipment operators and site personnel could receive minor radiological exposures during removal activities. However, these exposures could be controlled using standard radiation control measures. Animals have a tendency to burrow, and the tap roots of certain plants common to the INEEL have been measured to 40 ft long. However, the thickness of the soil layer would inhibit intrusion by many burrowing animals and plant species.

The long-term effectiveness of this design after the 100-year institutional control period is unknown. Use of native plants as a surface vegetation also would reduce biointrusion by other, deeper rooting plant species for the short-term. The potential for root intrusion by deep-rooting plants including sagebrush into contaminated soils exists and could result in mobilization of radionuclides to environmental receptors.

The native soil design would be easy to construct. Long-term inspection and maintenance requirements could be implemented easily. Long-term monitoring requirements including radiation surveys could be implemented easily during the institutional control period. The technical implementability is high, but administrative implementability cannot be fully assessed until state acceptance and community acceptance have been evaluated.

The costs of monitoring, access restrictions, and surface water diversion are nearly the same for each containment alternative. Assuming the air monitoring would be performed as part of an INEEL-wide program, long-term air monitoring costs would be relatively low. Estimated capital and operating costs for Alternative 3a are provided in Table 11-1.

11.1.3.4.2 Alternative 3b: Excavation, Consolidation, and Containment within WAG 5 with an Engineered Barrier (SL-1 Type Cover)

11.1.3.4.2.1 Description—The engineered barrier of this alternative is similar to that designed for closure of the SL-1 Burial Ground (Parsons 1997). This design is adapted from rock covers used to isolate uranium mill tailings and includes a biobarrier consisting of 4 in. of gravel, 12 in. of cobbles, and another 4 in. of gravel constructed over the compacted soil foundation. Two ft of rock armor would be added as a surface covering. Cap sidewalls would have a 1:4 (vertical to horizontal) slope, but layers would otherwise not be sloped. The total cap thickness would be approximately 4 ft, not including any foundation layer required.

The design is intended to isolate contaminants, prevent inadvertent human intrusion, and minimize plant and animal intrusion. This design does not reduce infiltration of precipitation, does not divert precipitation or runoff from underlying waste, and does not promote lateral drainage of infiltration within the cap. This cap is actually likely to increase infiltration relative to undisturbed soils because any rainfall or snow melt on the cap readily moves beyond the depth of evaporation through the rock-armor and gravel-cobble layers. No transpiration would act to remove water, because no vegetation would be present. This barrier, therefore, does not reduce risks resulting from infiltration and leaching of COCs to groundwater and would actually promote COC migration through the soil column.

This type of engineered barrier has been constructed on the INEEL at sites where infiltration and leaching to groundwater are not a concern. The GWSCREEN calculations presented in the RI/BRA demonstrate that migration of contaminants from WAG 5 soils to groundwater will not result in groundwater contamination in excess of risk-based levels. For this FS, groundwater protection is not an RAO for the WAG 5 radiologically contaminated soil sites.

11.1.3.4.2.2 Evaluation—The short-term effectiveness of this alternative for protecting human health is moderate. Equipment operators and site personnel would receive minor radiological exposures during removal activities. However, these exposures can be controlled by use of standard radiation control measures. Short-term protection of the environment is high because adequate contamination controls would be specified.

This alternative is highly effective in preventing long-term exposure to contaminated soils at the covered area. Surface radiation exposures would be reduced to background levels by the shielding effects of the various layers of natural material. The cover is designed for long-term isolation with minimal maintenance requirements. The engineered cover for this alternative would be effective in preventing biointrusion and would add a high level of inadvertent intruder protection by both the mass and impermeability of materials overlying the contaminated soils.

Installation of this cover is technically implementable, but establishing a new disposal unit within WAG 5 may be resisted. Installation costs are higher than the native soil cover. Both short-term and long-term aspects of this alternative are readily implementable. Installation experience and services are available through SL-1 project experience, and construction materials are readily available on-Site. Basalt riprap can be obtained from the lava flows that cover much of the INEEL land surfaces. Gravel may be obtained on the INEEL or elsewhere locally. Long-term monitoring requirements including radiation surveys could be implemented easily during the institutional control period.

The estimates for long-term costs of monitoring, access restrictions and cover inspection and maintenance are nearly the same for both of the cover options. Long-term inspection and maintenance requirements are minimal. Long-term air monitoring costs would be relatively low, assuming that the air monitoring would be performed as part of INEEL-wide programs. Estimated capital and operating costs for the SL-1 type containment alternative is provided in Table 11-1.

11.1.4 Alternatives 4a and 4b: Removal and Disposal

Alternatives 4a and 4b are evaluated concurrently because the only difference between them is the disposal site for the soils. For cost-estimating purposes, the disposal of contaminated soil in the proposed INEEL soil repository at the INTEC will be evaluated for Alternative 4a. The same excavation and transportation costs to the INTEC will be evaluated for Alternative 4b, but additional costs of rail transport from the INTEC, which has a railroad loading facility for off-Site transport, to a private off-Site disposal facility and disposal fees for the facility also will be evaluated.

11.1.4.1 Description. Alternatives 4a and 4b consist of the following remedial actions to remove and dispose of contaminated soil at WAG 5 radiologically contaminated soil sites:

- Removal using conventional excavation techniques
- Segregation and incineration of vegetation
- Real-time analyses using gamma surveys for radionuclides and portable inductively coupled plasma (ICP) spectrometry for nonradioactive chemicals
- Characterization and packaging
- Verification sampling
- Transportation

- Disposal in a low-level waste soil and debris landfill
- Site restoration.

11.1.4.1.1 Removal—Removal of contaminated soil from WAG 5 sites of concern could be achieved using conventional excavation equipment and standard engineering and administrative controls for radiation exposure and air emissions. Currently practiced radiological controls would be used to reduce radiation exposure to the operators. Radiological controls could consist of limiting the amount of time an operator can work in the area, requiring personnel to wear personal protective clothing, and using distance and shielding to reduce radiation exposure. Air emissions would be controlled by the use of water sprays or soil fixatives to suppress dust during soil excavation and removal.

The rates at which contaminated soil could be retrieved from WAG 5 sites would depend on the capabilities of the excavation equipment, characterization requirements, material handling equipment, and quality assurance requirements. For example, removal rates of 200 yd^3/hour can be achieved using backhoes. The number of excavators and personnel specified to perform removal activities also would influence the rate of waste removal.

The contaminated media would consist primarily of silty sand to loose sandy gravels and are expected to be classified as contact-handled low-level waste. The relatively shallow depths of contaminated media at WAG 5 sites (approximately 3 m [10 ft] maximum) would allow for excavation using front-end loaders, backhoes, and soil vacuum equipment.

Areas planned for excavation would be gridded, characterized, and excavated in discrete depth intervals. Excavation would only proceed to the depths at which contamination above the PRGs was encountered. Sampling and analysis of soil underlying clean intervals would be used to verify that all soil contaminated above PRGs had been removed.

11.1.4.1.2 Segregation and Incineration of Vegetation—This alternative would require removal of vegetation from WAG 5 contaminated soil sites and excavating contaminated soil. Vegetation will be sized using a wood chipper or similar type of equipment. If required by safety analysis, a small primary confinement building with negative pressure ventilation will be used during the chipping operation. The sized vegetation will be boxed in cardboard containers and transported to the WERF incinerator for disposal. After excavation, these sites would be backfilled with clean soil. The effectiveness of conventional excavation equipment has been demonstrated in retrieving radioactive soil and debris in the OU 10-06 Removal Action and other INEEL remedial responses (Parsons 1996).

11.1.4.1.3 Real-Time Gamma Surveys and ICP Analysis—Real-time gamma surveys and real-time ICP analysis could be used to delineate the extent of contamination for removal and to reduce the volume of clean soil removed and commingled with contaminated soil. As determined in the remedial design phase, laboratory analysis of representative grab samples would be required to verify the real-time assessment.

11.1.4.1.4 Characterization and Packaging—For Alternative 4a, use of the proposed INEEL Soil Repository, no special packaging would be required and bulk shipment of soil would be accepted. Likewise, for Alternative 4b, use of an off-Site disposal facility, such as Envirocare, for low-level radiologically contaminated soils, special packaging also would not be required and bulk shipments would be accepted. Two assumptions are incorporated into the alternatives: (1) that contaminated soils from WAG 5 sites meet the appropriate facility waste acceptance criteria for activity and (2) that WAG 5 site soils are not RCRA-hazardous.

Efficient logistics dictate that characterization should occur concurrently with retrieval activities. Real-time monitoring during excavation would serve as a component of characterization. As deemed necessary, laboratory analysis of an agreed upon number of representative grab samples would be required to verify the real-time assessment.

11.1.4.1.5 Verification Sampling—Verification sampling, which consists of radiation surveys and soil sampling and analysis, would be performed to confirm that all contamination exceeding PRGs was removed from the site.

11.1.4.1.6 Transportation—For Alternatives 4a and 4b, trucks would be used to transport the soils from WAG 5 to the INTEC and the sized vegetation to the WERF incinerator. These costs are the same for both alternatives. Additional costs would be associated with Alternative 4b for the rail transport of the soil from the INTEC (the nearest railhead location) to Envirocare in Clive, Utah. Road distance from WAG 5 to the INTEC is approximately 3 miles, and rail distance from INTEC to Envirocare is approximately 300 miles.

Transport of soils from WAG 5 to the INTEC would not require use of public roads. Dump trucks would be positioned near the excavation site so that loaders and backhoes can place the contaminated soil directly into the dump truck. When a dump truck has been filled, the operator will remove soil from the outside of the truck box. A tarp will be unrolled over the truck box and secured to prevent accidental release of soil during transit. The dump truck will transport the soil to the INTEC for disposal at the INEEL repository, Alternative 4a, or to the rail transfer station for shipment to the private off-Site disposal facility, Alternative 4b. Envirocare is specified as the representative disposal facility for contaminated materials removed from WAG 5 sites for costing purposes. Other options may be selected in the ROD or during the remedial design phase, with the concurrence of DOE, EPA, and IDHW.

11.1.4.1.7 Disposal—Requirements for disposing of low-level waste at the proposed INEEL repository have not been officially established but are assumed to be the same as those of an off-Site disposal facility. The requirements for disposing of low-level waste at Envirocare are defined in the facility license. The facility material qualification and acceptance process are summarized as follows:

1. Waste must be fully characterized by the generator of the waste

2. If waste is RCRA-hazardous, all appropriate EPA hazardous waste codes must be listed in Envirocare's permit

3. If waste is RCRA-hazardous or land disposal restriction (LDR) waste, it must meet applicable RCRA treatment standards

4. Waste must have radioisotopes and activities within the limits of Envirocare's license

5. Waste must have physical properties that meet requirements of Envirocare's license (e.g., no free liquids, manageable debris, and optimum moisture content)

6. Incoming waste must arrive properly transported and packaged and must be within characterization and tolerances.

The Envirocare license specifies activity limits for TRU radionuclides, rather than a limit for total TRU waste. Envirocare will accept low-level soils shipped in bulk (i.e., rail cars or dump trucks); therefore, packaging is not required. Envirocare requires the adjustment of soils to optimum moisture content before shipment to maximize compaction when disposed of at the landfill. Given that water sprays will likely be used to control fugitive dust emissions during excavation, adjusting to optimal moisture likely would not add cost. Soils excavated from WAG 5 sites are assumed to meet the waste acceptance criteria for Envirocare.

11.1.4.1.8 Site Restoration—Following removal of the contaminated soil from WAG 5 sites, each site would be restored by contouring to the conditions of the surrounding landscape and backfilling excavated areas with clean materials. Backfilled areas then would be compacted to prevent future subsidence. Sites would be revegetated as appropriate in accordance with INEEL revegetation guidance (DOE-ID 1989).

11.1.4.2 Evaluation. The short-term effectiveness of both Alternatives 4a and 4b for protecting human health is moderate. Equipment operators and site personnel would be exposed to minor radiological exposures during removal activities; however, these exposures could be controlled using standard radiation control measures. Long-term protection of human health and the environment is high because contaminated soil would be removed from the sites. The toxicity, volume, and mobility of contaminants would not be reduced by this alternative.

Technical and administrative implementability of this alternative is high. Proposed excavation equipment (including necessary modifications to protect operators) is currently available. Characterization, packaging, transportation, and disposal of contaminated materials all use currently available technologies. The trained personnel and specialized equipment required would be available. Long-term implementability is high because the contamination would be removed. No long-term inspection and maintenance would be required because contamination would be removed.

The estimated short-term cost of this alternative is high. The extra costs associated with Alternative 4b off-site transportation and disposal are higher than those for Alternative 4a. Both alternatives would have significant costs associated with the safety analysis, satisfying ARARs, and operational and capital costs. The primary capital cost associated with this alternative would be disposal facility fees and transportation. Operation and maintenance costs are high during the excavation and disposal period because of the radiological considerations involved with safety and decontamination, but these operations would take less than 1 year to complete. Estimated capital and operating costs for the removal and disposal alternatives are provided in Table 11-1.

11.1.5 Alternatives 5a and 5b: Removal, Ex Situ Sorting, and Disposal

Alternatives 5a and 5b are evaluated concurrently because the only difference between them is the disposal site for the soils. These alternatives are nearly identical to Alternatives 4a and 4b. The exception is that ex situ soil sorting is included. Soils radiologically contaminated at levels higher than PRGs would be treated by a separation process such as the Segmented Gate System. See Section 11.1.4 for discussions about the other components of these alternatives. The components of Alternatives 5a and 5b that vary significantly from Alternatives 4a and 4b are discussed below.

11.1.5.1.1 Description—Surveys, real-time field analysis, and laboratory analysis of samples will be used to identify soils requiring remediation. Conventional excavation equipment would be used to remove the contaminated soil. A front-end loader would be used to deposit the soil into a screen plant and hammer mill for sizing.

Chemically contaminated soils will be sorted using real-time ICP analysis. The radioactively contaminated soil would be conveyed to a feed hopper and moved underneath an array of sensitive radiation detectors to determine the activity and location of the contamination. Material on the conveyer belt would be assayed and radioactive content logged by the computer. Based on count rates from the detectors, decision logic routines would be used to determine whether the soil is diverted as above or below PRGs. Contaminated soil diverted by the gates would be placed into dump trucks for transportation to a disposal site. Soil that was assayed as below PRGs would be routed by a stacking conveyer to a storage pile for eventual return to the excavation site.

The rates at which contaminated soil could be retrieved from WAG 5 sites would depend on the capabilities of the excavation and separation equipment, characterization requirements, material handling equipment, and quality assurance requirements. The throughput of the soil separation treatment process varies from 5 to 30 yd^3/hour, depending on the radionuclide of interest and soil characteristics.

11.1.5.2 Evaluation. The short-term effectiveness of both Alternatives 5a and 5b for protecting human health is moderate. Equipment operators and site personnel would be exposed to minor radiological exposures during removal and treatment activities; however, these exposures could be controlled using standard radiation control measures. Long-term protection of human health and the environment is high because contaminated soil would be removed from WAG 5 contaminated soil sites. Though the volume of contaminated soil would be reduced by this alternative, the toxicity and mobility of contaminants would not be reduced.

Technical and administrative implementability of this alternative is moderate. Proposed excavation and soil separation equipment (including necessary modifications to protect operators) are currently available, but the soil separation technology has not been demonstrated on the soils at WAG 5. Characterization, packaging, transportation, and disposal of contaminated materials all use currently available technologies. The trained personnel and specialized equipment required would be available. No long-term care would be required at the sites, because all contamination would be removed.

The short-term cost of this alternative is high. The costs for the soil separation treatment are moderate to high, and the costs associated with Alternative 5b off-Site transportation and disposal are higher than those for Alternative 5a. Both alternatives would have significant costs associated with the safety analysis, satisfying ARARs, and operational and capital costs. Operation and maintenance costs are high during the excavation, treatment, and disposal period because of the radiological considerations involved with safety and decontamination, but these operations would take less than 2 years to complete. No long-term monitoring costs would be incurred, assuming all contamination would be removed from the sites. Estimated capital and operating costs for the removal, treatment, and disposal alternatives are provided in Table 11-1.

11.2 Remedial Alternatives for the ARA-02 Sanitary Waste System

11.2.1 Alternative 1: No Action

11.2.1.1 Description. The NCP requires consideration of a no action alternative to serve as a baseline for evaluation of other remedial alternatives. No land use restrictions, controls, or active remedial measures are implemented at the site. Risk levels would be reduced only through radioactive decay or other natural processes. Environmental monitoring can be part of a no action alternative while DOE has institutional control of the INEEL, which includes the site operational period and at least 100 years following site closure. The no action alternative is applicable to sites with contamination that does not exceed the level of unacceptable risk and is in compliance with ARARs.

Environmental monitoring would be performed to detect contaminant migration and to identify exposures via soil, air, and groundwater. Monitoring results would be used to determine the need for any future remedial actions necessary to protect human health and the environment. Monitoring would be conducted until a future review of the remedial action determined that further monitoring is not required.

Soil, air, and groundwater environmental monitoring activities would be performed under WAG-wide and INEEL-wide comprehensive monitoring programs to the extent practicable. Radiological surveys would be performed at sites with contaminated media remaining in place as part of this remedial action until Site-wide environmental monitoring programs are implemented. Groundwater monitoring requirements would be identified in the report produced from the 5-year review. Air monitoring would be conducted as part of the INEEL-wide air-monitoring program.

11.2.1.2 Evaluation. The no action alternative could be implemented easily. However, the no action alternative is ineffective at reducing identified risks and does not meet RAOs. Long-term monitoring costs are moderate. Estimated costs for the no action alternative are provided in Table 11-2.

11.2.2 Alternative 2: Limited Action

11.2.2.1 Description. Alternative 2 consists of the following remedial actions to protect human health and the environment against potential risks associated with ARA-02:

- Institutional controls
  - Monitoring and maintenance of the existing soil cover
  - Surface water diversion
  - Access restrictions
  - Long-term environmental monitoring, the same as required for the no action alternative.

Maintenance of surface soil integrity, including repair of subsidence and erosion effects, would be performed as necessary to prevent surface exposure of subsurface contamination. Existing soil covers would be maintained using the same type of native soil present at WAG 5. Surface water diversion measures would be used to prevent ponding. Contour grading, drainage ditches, and other appropriate measures would be used to direct surface water away from the sites to natural or engineered drainage as required.

Access to the INEEL is currently restricted for purposes of security and public safety. Because WAG 5 sites are located within the boundaries of the INEEL, Site-wide access restrictions would limit accessibility for at least 100 years. In addition, existing fences surrounding WAG 5 sites would be maintained and replaced as necessary. Installation of additional fences or relocation of the existing fences also may be necessary. Other access control measures may include warning signs, assessing trespassing fines, and establishing training requirements for persons allowed access. Land-use restrictions may be specified if government control of the INEEL is not maintained throughout the institutional control period.

Site inspections and maintenance of fences and surface drainage would be implemented. Monitoring and inspection results would be evaluated during 5-year reviews to determine whether active remediation would be required at specific sites.

11.2.2.2 Evaluation. The limited action alternative could be implemented easily for both the short- and long-term because the specified actions are a continuation of the existing management practices. Soil cover maintenance, surface water diversion, and fence maintenance would be performed only on an as-needed basis. Estimated costs for the limited action alternative are provided in Table 11-2.

This alternative is effective for protecting human health during the 100-year period of institutional control. However, after institutional control of the INEEL is discontinued, risks would be the same as for the no action alternative. Risks to human health and the environment will remain at unacceptable levels after 100 years at all sites of concern. Ecological risks would not be reduced by institutional controls. Therefore, the limited action alternative is not an effective long-term remedy. This alternative is screened from further consideration for the ARA-02 sanitary waste system.

11.2.3 Alternative 3: Removal, Ex Situ Thermal Treatment, and Disposal

11.2.3.1 Description. Alternative 3 would consist of removing the waste from the ARA-02 seepage pit, excavating the surrounding soils, removing the seepage pit blocks, septic tanks, and pipelines, and restoring the site. The ARA-02 seepage pit sludge would be packaged for shipment and incineration at WERF; the treatment residuals would be transported for disposal at a permitted disposal facility off the INEEL, such as Envirocare.

During excavation soil sampling and analysis will be performed to verify that the soils are not RCRA-characteristic and that the COCs are below the PRGs for soil. In the event that soils are excavated that are considered RCRA-hazardous, they will be stabilized and shipped to a permitted off-Site disposal facility such as Envirocare or to the on-Site soil repository if it is constructed and can accept RCRA-hazardous waste. If soils are discovered with radiological contamination exceeding PRGs for soil, the contaminated soils would be disposed of in conjunction with the clean up of ARA-23. The clean soils will be returned to the excavation site.

The structural components of the system (i.e., three septic tanks and pipelines) and the pumice blocks composing the seepage pit would be sampled for radiological, RCRA, and PCB contaminants. It is assumed the blocks will be no more contaminated than the existing sludge and, hence, will meet criteria for disposal at a permitted facility off the INEEL such as Envirocare. If required, the blocks can be encapsulated by Envirocare before disposal. Because of the porous nature of the pumice blocks, decontamination to meet standards for disposal as low-level waste is not practical. The septic tanks are made of concrete and the piping made of clay. Therefore, decontamination to meet the RCRA clean debris standard is not considered feasible. The tanks and piping will be disposed in a permitted off-Site facility such as Envirocare. In the event that the ICDF is constructed and accepts RCRA-listed waste, the tanks and piping can be disposed of on-Site. Following removal of the ARA-02 sanitary waste system, the excavated site will be backfilled with clean soils, compacted, and revegetated in accordance with INEEL guidelines (DOE-ID 1989).

11.2.3.2 Evaluation. The short-term effectiveness of this alternative for protecting human health is moderate. Equipment operators and site personnel would be exposed to radiological and chemical hazards during removal activities. However, exposures could be controlled using standard administrative and engineering control measures. Short-term protection of the environment is high because adequate contamination control measures would be used and the sites are located in previously disturbed areas. Long-term protection of human health and the environment is highly effective because all waste, contaminated soil, and debris would be removed. The toxicity, volume, and mobility of contaminants would be reduced through treatment.

Short-term technical implementability of this alternative is high. The proposed waste-removal equipment and excavation equipment are currently available. Characterization, packaging, treatment of the ARA-02 seepage pit sludge at WERF and disposal of the ARA-02 seepage pit pumice blocks,

Table 11-2. Net present value of capital, operating and maintenance, and total cost of remedial alternatives for the ARA-02 sanitary waste system.

	ARA-02 Remedial Alternatives			
Description	1 No Action	2 Limited Action	3 Removal, Ex Situ Thermal Treatment, and Disposal	4 In Situ Stabilization and Encapsulation
FFA/CO management and oversight				
Program management	250,000	375,000	375,000	375,000
Remedial action document preparation				
Remedial design/remedial action scope of work	54,000	54,000	54,000	54,000
Remedial action work plan	63,000	63,000	63,000	63,000
Packaging, shipping, transportation documentation	NA[a]	NA	48,000	NA
Remedial action report	48,000	48,000	48,000	48,000
WAG-wide 5-year reviews	141,000	141,000	141,000	141,000
Remedial design documentation preparation				
Safety analysis documentation	100,500	100,500	100,500	100,500
Sampling and analysis plan	108,000	108,000	108,000	108,000
Pre-final inspection report	7,500	7,500	7,500	7,500
Remedial design				
Added institutional controls—5-year reviews	32,000	32,000	32,000	32,000
Title design construction document package	67,960	74,960	98,200	95,800
Remedial action—construction subcontract				
Site characterization	80,000	80,000	20,250	20,250
Construction subcontract	274,040	312,229	492,773	424,681
Project/construction management	60,500	45,916	80,186	83,499
Total Capital Costs	**1,286,500**	**1,442,105**	**1,668,409**	**1,553,230**
Remedial action—operations (100-year duration)				
Program management	3,385,000	3,385,000	NA	3,385,000
WAG-wide 5-year review for 100 years	3,243,000	3,243,000	NA	3,243,000
Added institutional controls—5-year review for 100 years	640,000	640,000	NA	640,000
Continued/new construction caretaker/maintenance	3,013,620	3,084,434	NA	2,160,000
Operations, maintenance, materials, and disposal	NA	NA	NA	NA
Decontamination and dismantlement of facilities	NA	NA	NA	NA
Surveillance and monitoring	4,120,000	4,120,000	NA	1,120,000
Total Operations Costs (100 years)	**14,401,620**	**14,472,434**	**NA**	**10,548,000**
CAPITAL AND OPERATIONS COSTS SUBTOTAL	**15,688,120**	**15,914,539**	**1,668,409**	**12,101,230**
Contingency 30%	4,706,436	4,774,361	500,522	3,630,369
GRAND TOTAL	**20,394,556**	**20,688,900**	**2,168,931**	**15,731,599**
Total Project Costs in Net Present Value[b]	**9,346,452**	**9,236,522**	**2,019,265**	**7,500,857**

a. NA = not applicable

b. The net present value is a way to calculate cost estimates that factors in inflation but allows for equal comparison of long-term and short-term alternatives.

structural components, and treated sludge residuals all use currently available technologies and operating facilities. The required trained personnel and specialized equipment would be available. No long-term monitoring or inspection would be required because all contaminated media would be removed from the site.

The estimated cost of this alternative is low.

11.2.4 Alternative 4: In Situ Stabilization and Encapsulation

11.2.4.1 Description—Alternative 4 would consist of partially filling the seepage pit with soil and then grouting the seepage pit sludge and pumice blocks in place. In addition, the three empty concrete septic tanks and associated piping would be filled with grout. Jet grouting would be used in the seepage pit to ensure the sludge was adequately mixed with the grout material to stabilize the waste and completely encapsulate the entire seepage pit system. Jet grouting would be performed by drilling in a 2-ft grid pattern over the entire footprint of the seepage pit to bedrock (10 ft below ground surface) and then injecting grout under high pressure as the drill bit is withdrawn. After the seepage pit is stabilized and encapsulated, the remainder of the septic system would be filled with grout using a gravity feed method.

Institutional controls and environmental monitoring would be implemented to restrict access and confirm that contamination was not migrating from the site. Institutional controls would include deed restrictions and fencing. The environmental monitoring would include groundwater and vadose zone monitoring, radiation surveys, and soil sampling and analysis. Five-year reviews would be conducted to evaluate the effectiveness of the institutional controls and treatment.

11.2.4.2 Evaluation—The short-term effectiveness of this alternative is moderate. Hazards to workers during implementation include ejection of grout and construction hazards. Risks to workers could be reduced through engineering and administrative controls. This alternative would provide moderately effective long-term protection of human health and the environment. The toxic organics, radionuclides, and toxic metals would not be destroyed, but would be stabilized or encapsulated in a grout-type matrix. Hence, leaching of the contaminants to groundwater would be reduced and mobilization via plant uptake and animal intrusion would be prevented. The exposure pathways to workers, future residents, and ecological receptors would be reduced. However, the grout will degrade over long periods of time, making contaminant migration a possible future problem.

Short-term technical implementability of this alternative is high. The proposed jet grouting technique has been successfully demonstrated at the INEEL and the necessary equipment is currently available. The trained personnel and specialized equipment required would be available. Long-term monitoring and inspection would be required because contaminated media remain at the site. The estimated costs of Alternative 4 are high.

11.3 Remedial Alternatives for the ARA-16 Radionuclide Tank

11.3.1 Alternative 1: No Action

11.3.1.1 Description. The NCP requires consideration of a no action alternative to serve as a baseline for evaluation of other remedial alternatives. No land-use restrictions, controls, or active remedial measures are implemented at the site. Risk levels would be reduced only through radioactive decay or other natural processes. Environmental monitoring can be part of a no action alternative while DOE has institutional control of the INEEL, which includes the site operational period and at least

100 years following site closure. The no action alternative is applicable to sites with contamination that does not exceed the level of unacceptable risk and is in compliance with ARARs.

Environmental monitoring would be performed to detect contaminant migration and to identify exposures via soil, air, and groundwater. Monitoring results would be used to determine the need for any future remedial actions necessary to protect human health and the environment. Monitoring would be conducted until a future review of the remedial action determined that further monitoring is not required. Soil, air, and groundwater environmental monitoring activities would be performed under WAG-wide and INEEL-wide comprehensive monitoring programs to the extent practicable. Groundwater or vadose zone monitoring would be implemented at the ARA-16 tank, and annual tank integrity testing would be performed because RCRA-regulated materials would be left in the tank. Radiological surveys would be performed at sites with contaminated media remaining in place as part of this remedial action until Site-wide environmental monitoring programs are implemented. Groundwater monitoring requirements would be identified in the report produced from the 5-year review. Air monitoring would be conducted as part of the INEEL-wide air-monitoring program.

11.3.1.2 Evaluation. The no action alternative could be implemented easily. However, the no action alternative is ineffective at reducing identified risks and does not meet RAOs. Long-term monitoring costs are moderate . Estimated costs for the no action alternative are provided in Table 11-3.

11.3.2 Alternative 2: Limited Action

11.3.2.1 Description. Alternative 2 consists of the following remedial actions to protect human health and the environment against potential risks associated with ARA-16:

- Institutional controls
  - Monitoring and maintenance of the existing soil cover
  - Surface water diversion
  - Access restrictions
  - Long-term environmental monitoring as for the no action alternative.

Maintenance of surface soil integrity, including repair of subsidence and erosion effects, would be performed as necessary to prevent surface exposure of subsurface contamination. Existing soil covers would be maintained using the same type of native soil present at WAG 5. Surface water diversion measures would be used to prevent the accumulation of water on or near the site. Contour grading, drainage ditches, and other appropriate measures would be used to direct surface water away from the sites to natural or engineered drainage as required.

Access to the INEEL is currently restricted for purposes of security and public safety. Because WAG 5 sites are located within the boundaries of the INEEL, Site-wide access restrictions would limit accessibility for at least 100 years. In addition, existing fences surrounding WAG 5 sites would be maintained and replaced as necessary. Installation of additional fences or relocation of the existing fences also may be necessary. Other access control measures may include warning signs, assessing trespassing fines, and establishing training requirements for persons allowed access. Land-use restrictions may be specified if government control of the INEEL is not maintained throughout the institutional control period.

Table 11-3. Net present value of capital, operating and maintenance, and total cost of remedial alternatives for the ARA-16 radionuclide tank.

Description	1 No Action	2 Limited Action	3a ISV of the ARA-16 Tank at ARA-I	3b1 Removal and ISV of the ARA-16 Tank at TAN	3b2 ISV of the ARA-16 Tank Waste at TAN	4 Removal, Ex Situ Thermal Treatment, and Disposal	5 Removal, Ex Situ Stabilization, and Disposal
	ARA-16 Radionuclide Tank Remedial Alternatives						
FFA/CO management and oversight							
Program management	250,000	375,000	375,000	375,000	375,000	375,000	375,000
Remedial action document preparation							
Remedial design/remedial action scope of work	54,000	54,000	54,000	54,000	54,000	54,000	54,000
Remedial action work plan	63,000	63,000	63,000	63,000	63,000	63,000	63,000
Packaging, shipping, transportation documentation	NA[a]	NA	NA	48,000	48,000	48,000	48,000
Remedial action report	48,000	48,000	48,000	48,000	48,000	48,000	48,000
WAG-wide 5-year reviews	141,000	141,000	141,000	141,000	141,000	141,000	141,000
Remedial design documentation preparation							
Safety analysis documentation	100,500	100,500	100,500	100,500	100,500	100,500	100,500
Sampling and analysis plan	108,000	108,000	108,000	108,000	108,000	108,000	108,000
Pre-final inspection report	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Remedial design							
Added institutional controls—5-year reviews	32,000	32,000	32,000	32,000	32,000	32,000	32,000
Title design construction document package	67,960	74,960	283,160	229,200	287,200	287,200	287,200
Remedial action—construction subcontract							
Site characterization	80,000	80,000	20,250	32,600	32,600	20,250	20,250
Construction subcontract	274,040	312,229	1,617,099	1,268,455	2,074,973	1,977,339	2,270,681
Project/construction management	60,500	45,916	164,390	241,727	421,841	400,196	432,371
Total Capital Costs	**1,286,500**	**1,442,105**	**3,013,899**	**2,748,982**	**3,793,614**	**3,661,985**	**3,987,502**
Remedial action—operations (100-year duration)							
Program management	3,385,000	3,385,000	3,385,000	NA	NA	NA	NA
WAG-wide 5-year review for 100 years	3,243,000	3,243,000	3,243,000	NA	NA	NA	NA

Table 11-3. (continued).

Description	1 No Action	2 Limited Action	3a ISV of the ARA-16 Tank at ARA-I	3b1 Removal and ISV of the ARA-16 Tank at TAN	3b2 ISV of the ARA-16 Tank Waste at TAN	4 Removal, Ex Situ Thermal Treatment, and Disposal	5 Removal, Ex Situ Stabilization, and Disposal
	ARA-16 Radionuclide Tank Remedial Alternatives						
Added institutional controls—5-year review for 100 years	640,000	640,000	640,000	NA	NA	NA	NA
Continued/new construction caretaker/maintenance	3,013,620	3,084,434	2,016,400	NA	NA	NA	NA
Operations, maintenance, materials, and disposal	NA	NA	NA	NA	NA	NA	NA
Decontamination and dismantlement of facilities	NA	NA	NA	NA	NA	NA	NA
Surveillance and monitoring	4,120,000	4,120,000	120,000	NA	NA	NA	NA
Total Operations Costs (100 years)	**14,401,620**	**14,472,434**	**9,404,400**	**NA**	**NA**	**NA**	**NA**
CAPITAL AND OPERATIONS COSTS SUBTOTAL	**15,688,120**	**15,914,539**	**12,418,299**	**2,748,982**	**3,793,614**	**3,661,985**	**3,987,502**
Contingency 30%	4,706,436	4,774,361	3,725,489	824,695	1,138,084	1,098,595	1,196,251
GRAND TOTAL	**20,394,556**	**20,688,900**	**16,143,788**	**3,573,677**	**4,931,698**	**4,760,580**	**5,183,753**
Total Project Costs in Net Present Value[b]	**9,346,452**	**9,236,522**	**8,573,538**	**3,841,956**	**4,580,008**	**4,421,868**	**4,812,534**

a. NA = not applicable

b. The net present value is a way to calculate cost estimates that factors in inflation but allows for equal comparison of long-term and short-term alternatives.

Site inspections and maintenance of fences and surface drainage would be implemented. Monitoring and inspection results would be evaluated during 5-year reviews to determine whether active remediation would be required at specific sites.

11.3.2.2 Evaluation. The limited action alternative could be implemented easily for both the short- and long-term because the specified actions are a continuation of existing management practices. Soil cover maintenance, surface water diversion, and fence maintenance would be performed only on an as-needed basis. Estimated costs for the limited action alternative are high. A summary of costs is provided in Table 11-3.

This alternative is effective for protecting human health and the environment during the 100-year period of institutional control. However, after institutional control of the INEEL is discontinued, risks to human health and the environment would be the same as for the no action alternative. Risks to human health and the environment will remain at unacceptable levels after 100 years at all sites of concern; therefore, the limited action alternative is not an effective long-term remedy. This alternative is screened from further consideration for the ARA-16 radionuclide tank.

11.3.3 Alternatives 3a, 3b1, and 3b2: In Situ Vitrification of the ARA-16 Tank

The following ISV alternatives were developed to address the ARA-16 radionuclide tank:

3a., Vitrify the tank, tank contents, and surrounding soils in place and cover with soil.

3b1., Excavate the ARA-16 tank leaving the contents within, transport the tank to TAN, bury near the V-tanks, and apply ISV to all of the tanks; excavate and decontaminate the associated piping and the tank vault for disposal at the proposed INEEL soil repository or the RWMC as low-level waste; and address contaminated soil in conjunction with the remedial action for ARA-23.

3b2., Remove the contents of the ARA-16 tank, containerize the contents, transport the contents to TAN, and inject into a V-tank for ISV; excavate and decontaminate the tank, associated piping, and the tank vault for disposal at the proposed INEEL soil repository or the RWMC as low-level waste; and address contaminated soil in conjunction with the remedial action for ARA-23.

The ISV of tank contents and soil and debris disposal alternatives are discussed in the following sections.

11.3.3.1 Alternative 3a: In Situ Vitrification of the ARA-16 Tank at the Existing Tank Site.

11.3.3.1.1 Description—Alternative 3a would consist of ISV of the waste tank system, including the vault and piping, and capping the treated area with a soil cover. Soil surrounding the tanks would be vitrified along with the tank system by establishing two planar-shaped ISV melts on opposite sides of the tank. The melts would grow together and process the tank system and its contents along with the surrounding soil as the melting progresses. After the melt cools, native soil would be added in lifts and compacted to bring the level to grade. The surface would be finished with a minimum 2% slope and vegetated in accordance with INEEL guidelines (DOE-ID 1989).

Radiological control technicians and industrial hygiene personnel would monitor air emissions and radiological exposures throughout the process. Administrative controls including access controls during melting and engineering controls including the containment shroud would be used to maintain exposures as low as reasonably achievable (ALARA) and minimize physical hazards.

Environmental monitoring would be conducted following completion of the remedial action to confirm that no contaminant migration from the treatment area is occurring. In addition, the effectiveness of the institutional controls and the need for further environmental monitoring or additional control measures, as applicable, would be evaluated in 5-year site reviews..

11.3.3.1.2 Evaluation—The short-term effectiveness of Alternative 3a is moderate. Hazards to workers during implementation include ejection of melt, thermal and electrical hazards, and construction hazards. Risks to workers could be reduced through engineering and administrative controls. This alternative would provide highly effective long-term protection of human health and the environment when combined with soil capping to provide shielding. The toxic organics would be destroyed and the radionuclides and toxic metals would be immobilized in a glassy matrix. The radionuclides and metals could not be mobilized via plant uptake, leaching to groundwater, or animal intrusion. Exposure to direct radiation would be reduced by the addition of a soil cover for shielding. The long-term effectiveness and permanence of the soil cover is lower than that for the vitrified waste form; therefore, the long-term effectiveness and permanence for this alternative is considered moderate.

The technical and administrative feasibility is uncertain. The ISV technology has not yet been applied to a tank with mixed waste. A cold test of a mockup simulation of the TSF-09/18 V-9 tank was recently performed, and results indicated that the planar melt technique could successfully vitrify a buried tank (Geosafe 1998).

The estimated costs of Alternative 3a are high.

11.3.3.2 Alternative 3b1: Removal and In Situ Vitrification of the ARA-16 Tank at Test Area North.

11.3.3.2.1 Description—Alternative 3b1 would consist of erection of a temporary structure equipped with shielding and a negative pressure ventilation system exhausted through HEPA filters, excavating the tank system and surrounding contaminated soils, transporting the tank with its contents to TAN, and burying the tank for ISV treatment with the V-tanks. The associated piping system would be decontaminated and disposed of with the concrete vault as low-level waste. Options for disposition of the contaminated soils are addressed under alternatives for contaminated soils in Section 11.1.

Health physics and industrial hygiene personnel would monitor air emissions and radiological exposures throughout the remediation process. Administrative controls including access controls during excavation and transport, and engineering controls including the confinement and shielding would be used to maintain ALARA exposures and minimize physical hazards.

11.3.3.2.2 Evaluation—The short-term effectiveness of this alternative is moderate. Hazards to workers during implementation include exposure to the tank waste during excavation and transport. Risks to workers could be reduced through engineering and administrative controls. This alternative would provide highly effective long-term protection of human health and the environment because the waste and contaminated debris would be removed from the site.

The technical and administrative feasibility is uncertain. Though transportation of the ARA-16 tank is feasible[a] and discussions with WAG 1 managers[b] indicate that a suitable location for burial within the area of the V-tanks is available, the ISV technology has not yet been approved for the V-tanks nor applied to buried tanks with mixed waste. A cold test of a mockup simulation of the TSF-09/18 V-9 tank was recently performed, and the results indicated that the planar melt technique could successfully vitrify buried tanks (Geosafe 1998). The burial of the ARA-16 tank at TAN would constitute disposal at a non-RCRA-compliant site; therefore, a waiver to RCRA disposal regulations would be required.

The costs of the alternative are low assuming WAG 5 funding will cover all costs associated with excavation, transport, reburial, and vitrification of the ARA-16 tank at TAN, and the costs of mobilization and demobilization, and preparation of the health and safety plans are shared with WAG 1.

11.3.3.3 Alternative 3b2: Removal and In Situ Vitrification of the ARA-16 Tank Waste at Test Area North.

11.3.3.3.1 Description—Alternative 3b2 would consist of erection of a temporary structure equipped with shielding and a negative pressure ventilation system exhausted through HEPA filters, removing the waste from the ARA-16 tank, containerizing the waste for shipment, transporting it to TAN, and injecting it into a V-tank for subsequent ISV treatment. The empty tank, associated piping, and vault would be excavated and decontaminated for disposal at the RWMC or the proposed ICDF. Options for disposition of the contaminated soils excavated during tank and vault removal are addressed under alternatives for contaminated soils in Section 11.1.

Radiological control technicians and industrial hygiene personnel would monitor air emissions and radiological exposures throughout the remediation process. Administrative controls including access controls during tank waste removal, excavation and transport, and engineering controls including shielding and confinement with remote operations would be used to maintain ALARA exposures and minimize physical hazards.

11.3.3.3.2 Evaluation—The short-term effectiveness of this alternative is moderate. Hazards to workers during implementation include exposure to high radiation during removal waste from the tank, transport to TAN, and injection into a V-tank. Risks to workers could be reduced through engineering and administrative controls. This alternative would provide highly effective long-term protection of human health and the environment because the waste and contaminated debris would be removed from the site. Though removal of the waste from the tank and transportation is feasible[c] and discussions with WAG 1 managers[d,e] indicate that the addition of the ARA-16 tank waste to the V-tanks would not pose

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a. Sivill, T. E., Cost Estimating, Interdepartmental personal communication with M. D. Ruska, manager of Packaging and Shipping, Lockheed Martin Idaho Technologies Company.

b. Interdepartmental personal communication between F. L. Webber, WAG 5 manager; and D. J. Kuhns, WAG 1 manager; and B. J. Broomfield, Lockheed Martin Idaho Technologies Company.

c. Interdepartmental personal communication between R. H. Meservey, Decontamination and Dismantlement Program; B. J. Frazee, Environmental Restoration; and B. J. Broomfield, Lockheed Martin Idaho Technologies Company.

d. Interdepartmental personal communication between F. L. Webber, WAG 5 manager; D. J. Kuhns, WAG 1 manager; and B. J. Broomfield.

any problems for treatment, the technical and administrative feasibility is uncertain. The ISV technology has neither been approved yet for the V-tanks nor applied to buried tanks with mixed waste. A cold test of a mockup simulation of the TSF-09/18 V-9 tank was recently performed, and the results indicated that the planar melt technique could successfully vitrify buried tanks (Geosafe 1998). Addition of the ARA-16 tank waste into one of the V-tanks at TAN is considered disposal in a non-RCRA-compliant system; therefore, a waiver from RCRA waste disposal regulations would be required.

Costs are low assuming that WAG 1 funding will cover all costs associated with vitrification of the V-tanks, leaving only the costs for excavation, packaging, transportation, and injection into a V-tank to WAG 5.

11.3.4 Alternative 4: Removal, Ex Situ Thermal Treatment, and Disposal

11.3.4.1 Description. Alternative 4 would consist of erection of a temporary structure equipped with shielding and a negative pressure ventilation system exhausted through HEPA filters, removing the waste from the ARA-16 tank, excavating the surrounding soils, removing the tank system, and restoring the site. The ARA-16 tank waste would be packaged in a high-integrity container for storage at the RWMC until the AMWFT is operational. At this time, no disposal facility is in operation that could accept the ARA-16 tank waste for treatment or disposal. However, it is anticipated that such a facility will become available in the future because other DOE waste with similar characteristics also require treatment and disposal. Discussions with AMWTF personnel[f] indicate that some waste exceeding the general waste acceptance criteria will be accepted on a case-by-case evaluation. Given the chemical and radiological characterization along with the very limited quantity of waste in the ARA-16 tank (less than 100 gal), this waste was selected as a candidate for treatment at the AMWTF.

During excavation, real-time gamma surveys would be used to delineate the extent of contamination and allow segregation of contaminated soils from clean soils. The contaminated soils would be disposed of in conjunction with the remediation of ARA-23. The clean soils will be returned to the excavation site.

The ARA-16 tank and associated piping will be decontaminated to the extent possible. It is assumed that these materials can be cleaned to meet criteria for disposal at either the proposed INEEL soil repository or the RWMC. The decontamination residue will be treated at WERF, and the residuals will be disposed of at a permitted disposal facility off the INEEL such as Envirocare. Because sampling results indicate the ARA-16 tank has not leaked, it is assumed that the vault and the gravel within the vault can be disposed of at the INEEL as low-level waste. The most likely location for disposal of the vault and gravel is either the RWMC or the proposed INEEL soil repository.

Following removal of the ARA-16 tank system, the excavated site will be backfilled with clean soils, compacted, and revegetated in accordance with INEEL guidelines (DOE-ID 1989).

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e. Minutes from a project manager conference call, September 9, 1998, when U.S. Department of Energy, Idaho Operations Office; U.S. Environmental Protection Agency; Idaho Department of Environmental Quality; and Lockheed Martin Idaho Technologies Company personnel discussed the disposal of the ARA-16 radionuclide tank with the V-tanks.

f. Schafer, J. J., Jr., Interdepartmental personal communication with B. J. Broomfield, Lockheed Martin Idaho Technolgies Company.

11.3.4.2 Evaluation. The short-term effectiveness of this alternative for protecting human health is moderate. Equipment operators and site personnel would be exposed to radiological and chemical hazards during removal activities. Control of exposures from the high radiation associated with the ARA-16 tank waste would require extensive administrative and engineering controls. Short-term protection of the environment is high because adequate contamination control measures would be used and the sites are located in previously disturbed areas. Long-term protection of human health and the environment is highly effective because all waste, contaminated soil, and debris would be removed. The toxicity, volume, and mobility of contaminants would be reduced through treatment.

Short-term technical implementability of this alternative is high. The proposed waste-removal equipment and excavation equipment are currently available. Storage of the ARA-16 tank waste at the RWMC and disposal of the ARA-16 tank system use currently available technologies and operating facilities. The trained personnel and specialized equipment required would be available. No long-term monitoring or inspection would be required because all contaminated media would be removed from the site.

The estimated cost of this alternative is low.

11.3.5 Alternative 5: Removal, Ex Situ Stabilization, and Disposal

11.3.5.1 Description. The actions under Alternative 5 are nearly the same as for Alternative 4, with the exception of the waste-treatment technology. The ARA-16 tank waste would be treated in a skid-mounted treatment system near the site by chemical stabilization. The treated waste would be packaged and transported for disposal at a permitted disposal facility off the INEEL, such as Envirocare. The contaminated soils, tank vault, and gravel would be disposed of at the INEEL, and clean soils will be returned to the excavation site. The RWMC is the most likely disposal facility, though this waste could be disposed of at the proposed ICDF or with the OU 5-12 contaminated soils if containment is selected as the preferred alternative. The stainless steel tank and piping system would be decontaminated and disposed of at the RWMC or the proposed ICDF as low-level waste. The site will be backfilled with clean soils, compacted, and revegetated in accordance with INEEL guidelines (DOE-ID 1989).

11.3.5.2 Evaluation. The short-term effectiveness of this alternative for protecting human health is low. Equipment operators and site personnel would be exposed to high radiological and chemical hazards during removal and treatment activities. Control of exposures from the high radiation associated with ARA-16 tank waste would require extensive administrative and engineering control measures. Short-term protection of the environment is high because adequate contamination control measures would be used and the sites are located in previously disturbed areas. Long-term protection of human health and the environment is high because all waste, contaminated soil, and debris would be removed from the site. The mobility of contaminants at the disposal facility would be reduced by the treatment, but the toxicity would not be reduced, the volume would increase, and the long-term stability of the waste form is not known. Hence, contaminant migration could present a future problem at the disposal site.

Technical implementability of this alternative is difficult and uncertain. Extensive treatability testing would be required to determine a suitable chemical stabilization formula for the ARA-16 tank waste, which has high concentrations of metals, organics, and radionuclides. It is also uncertain that criteria for disposal could be met for the ARA-16 tank waste after stabilization because the concentration of PCBs makes the waste subject to TSCA disposal requirements. Presently, no existing operating disposal facility could accept such waste, and the radiological levels may be too high for the proposed ICDF. The proposed waste removal equipment and excavation equipment are currently available. Characterization, packaging, and disposal of the ARA-16 tank system all use currently available technologies and operating facilities. The trained personnel and specialized equipment required would be available. No long-term monitoring or inspection would be required at these sites.

The cost of the alternative is low.

11.4 Screening of Alternatives Summary

In the preceding subsections, each remedial action alternative was defined to provide sufficient quantitative information to allow differentiation among the alternatives for effectiveness, implementability, and cost. Results of these evaluations are now used for comparing alternatives with each general response action (GRA) relative to each other. Screening on a relative basis allows for either eliminating alternatives from further evaluation or retaining alternatives for detailed analysis.

Alternatives may be screened from further consideration on the basis of relative effectiveness within a GRA or if an alternative is not implementable. An alternative can be screened on the basis of cost only when the relative effectiveness and implementability of other alternatives are equal. Alternatives also can be screened on the basis of unjustifiable cost relative to increased effectiveness or implementability. The screening process is only a preliminary evaluation, and alternatives are generally retained unless a clear basis for rejection is defined (EPA 1988).

11.4.1 Contaminated Soils

11.4.1.1 Alternative 1: No Action. As required by the NCP, the no action alternative was retained for detailed analysis to serve as the baseline for comparing other remedial action alternatives. However, the no action alternative would not address the risks identified in the BRA and would not satisfy RAOs established for WAG 5.

11.4.1.2 Alternative 2: Limited Action. The limited action alternative is effective for protecting human health during the 100-year period of institutional control but would provide little or no reduction of environmental risks. However, once the specified institutional control actions (i.e., surface water diversion, access restrictions, and environmental monitoring) are either no longer conducted or enforced, risks to both human health and the environment would be equivalent to the no action and would not satisfy RAOs. Therefore, this alternative was eliminated from further consideration for all sites.

11.4.1.3 Alternatives 3a and 3b: Excavation, Consolidation, and Containment within WAG 5. Both removal and containment options, Alternatives 3a and 3b, are effective in preventing exposure from the radiologically contaminated sites in the short-term. Alternative 3b provides better long-term protection for exposure to long-lived nuclides (Ag-108m and Ra-226) than Alternative 3a. Alternative 3b adequately prevents bio-intrusion, while Alternative 3a does not. Long-term maintenance costs are similar for both covers. Alternative 3b was retained for further evaluation in the detailed analysis of alternatives in Section 12, while Alternative 3a was screened because it does not provide adequate ecological protection and only minimal long-term effectiveness for the radionuclides.

11.4.1.4 Alternatives 4a and 4b: Removal and Disposal. Short-term cost estimates for excavation and disposal alternatives are significantly higher than for the containment alternatives. However, no long-term maintenance and monitoring costs would be incurred for any of the sites from which contamination would be removed, and long-term effectiveness would be higher. Alternative 4a short-term costs are less than those of Alternative 4b because the extra transportation costs are avoided and the disposal fees are lower. Alternatives 4a and 4b were retained for detailed analysis in Section 12.

11.4.1.5 Alternatives 5a and 5b: Removal, Ex Situ Sorting, and Disposal. This alternative would decrease the volume of contaminated soils removed from WAG 5 radiologically contaminated sites of concern. Though safety and shielding measures can be implemented to protect equipment operators, excavation with separation would result in higher short-term human health risks than any other alternative evaluated for WAG 5 contaminated soil sites. Assuming only a 50% reduction in soil volume, short-term costs for excavation, separation, and disposal alternatives are higher than for excavation and disposal alternatives because of the added cost for operating the segmented gate system. No long-term maintenance and monitoring costs would be incurred for any of the sites from which contamination would be removed, and long-term effectiveness would be high. These alternatives were retained for detailed analysis in Section 12.

11.4.2 ARA-02 Sanitary Waste System

11.4.2.1 Alternative 1: No Action. As required by the NCP, the no action alternative was retained for detailed analysis to serve as the baseline for comparing other remedial action alternatives. However, the no action alternative would not address the risks identified in the BRA and would not satisfy RAOs established for WAG 5.

11.4.2.2 Alternative 2: Limited Action. The limited action alternative is effective for protecting human health during the 100-year period of institutional control, but would provide little or no reduction of environmental risks. However, once the specified institutional control actions (e.g., surface water diversion, access restrictions, and environmental monitoring) are either no longer conducted or enforced, risks to both human health and the environment would be equivalent to the no action and would not satisfy RAOs. Therefore, the limited action alternative for ARA-16 tank waste was screened from further consideration.

11.4.2.3 Alternative 3: Removal, Ex Situ Thermal Treatment and Disposal. Alternative 3 provides high long-term effectiveness because all the waste and associated contaminated soils would be removed from the site, the waste would be treated to destroy the organic contaminants and reduce mobility of the toxic metals and radionuclides, and the treated waste, soil, and debris would be disposed of in a secure landfill. Short-term effectiveness is high because of the immediate availability of the WERF incinerator for treatment of the ARA-02 seepage pit sludge. Short-term costs are low, and no monitoring would be required after remediation. Therefore, Alternative 3, thermal treatment of the ARA-02 seepage pit sludge, was retained for detailed analysis in Section 12.

11.4.2.4 Alternative 4: In Situ Stabilization and Encapsulation. Alternative 4 provides moderate long-term effectiveness. Though contaminant mobility and exposure pathways will be reduced, the contaminants will not be destroyed or reduced and migration of contaminants is possible over long periods of time. Short-term effectiveness is moderate because of hazards to workers during implementation, though risks could be reduced through engineering and administrative controls. Short-term technical implementability of this alternative is high because the proposed jet grouting technique has been successfully demonstrated at the INEEL and the equipment and experienced personnel are currently available. Costs are high because monitoring would be required after remediation. Alternative 4, in situ stabilization and encapsulation, was retained for detailed analysis in Section 12.

11.4.3 ARA-16 Radionuclide Tank

11.4.3.1 Alternative 1: No Action. As required by the NCP, the no action alternative was retained for detailed analysis to serve as the baseline for comparing other remedial action alternatives. However, the no action alternative would not address the risks identified in the BRA and would not satisfy RAOs established for WAG 5.

11.4.3.2 Alternative 2: Limited Action. The limited action alternative is effective for protecting human health during the 100-year period of institutional control but would provide little or no reduction of environmental risks. However, once the specified institutional control actions (e.g., surface water diversion, access restrictions, and environmental monitoring) are either no longer conducted or enforced, risks to both human health and the environment would be equivalent to the no action alternative and would not satisfy RAOs. Therefore, the limited action alternative for ARA-16 tank waste was screened from further consideration.

11.4.3.3 Alternatives 3a, 3b1, and 3b2: In Situ Vitrification of the ARA-16 Tank. The ISV technology would destroy the organic contaminants in the tank waste and immobilize the toxic metals and radionuclides. The contaminated soils would be either treated in place to reduce mobility of the radionuclides (Alternative 3a) or would be removed and disposed of with soils from other WAG 5 sites (Alternatives 3b1 and 3b2). Exposure from external radiation would be prevented by the addition of a soil cap over the ISV treated area. The long-term effectiveness is high and monitoring requirements would be minimal.

Short-term effectiveness is moderate because of provisions necessary to prevent exposure to the high radiation in the tank waste and the complexities of the overall process. Short-term costs for Alternative 3a would be high, but costs for Alternatives 3b1 and 3b2 would be low assuming that the WAG 1 budget covers most of the costs for ISV at the TAN V-tanks. Therefore, Alternatives 3a, 3b1, and 3b2 were retained for detailed analysis in Section 12.

11.4.3.4 Alternative 4: Removal, Ex Situ Thermal Treatment and Disposal. Alternative 4 provides high long-term effectiveness because all the waste and associated contaminated soils would be removed from the site, the waste would be treated to destroy the organic contaminants and reduce mobility of the toxic metals and radionuclides, and the treated waste, soil, and debris would be disposed of in a secure landfill. Short-term effectiveness is high because of the immediate availability of the RWMC for storage of the ARA-16 tank waste for future treatment in the AMWTF. Short-term costs are low, and no monitoring would be required at these sites after remediation. Therefore, Alternative 4, thermal treatment of the ARA-16 tank waste, was retained for detailed analysis in Section 12.

11.4.3.5 Alternative 5: Removal, Ex Situ Stabilization, and Disposal. Stabilization of the ARA-16 tank waste has high effectiveness, low implementability, and high cost. Stabilization would be difficult and costly for ARA-16 because of the high level of radioactivity and toxic contaminants. While removal of the waste would be highly effective in addressing risk at the ARA-16 tank site and stabilization would reduce mobility of contaminants, the resulting waste form is not likely to meet criteria for disposal. Therefore, Alternative 5 was screened from further evaluation for the ARA-16 radionuclide tank.

11.5 References

40 CFR 300, 1997, *Code of Federal Regulations*, Title 40, "Protection of the Environment," Part 300, "National Oil and Hazardous Substances Pollution Contingency Plan."

DOE-ID, June 1989, *Guidelines for Revegetation of Disturbed Sites at the INEL*, DOE/ID-12114, U.S. Department of Energy, Idaho Operations Office.

Envirocare, 1997, *Material Quantification and Acceptance Process*, Envirocare of Utah, Inc.

EPA, October 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final*, EPA/540/G-89/004, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency.

Geosafe, September 1998, "Treatability Study for Planar In Situ Vitrification of INEEL Test Area North V-Tanks (Draft)," Geosafe Corporation, Richland, Washington.

LMITCO, February 1997, *Comprehensive RI/FS for the TRA OU 2-13 at the INEEL*, DOE/ID-10531, Lockheed Martin Idaho Technologies Company.

Parsons, September 1997, *Draft Final Remedial Action Report OU 5-05 Stationary Low-Power Reactor No. 1 and OU 6-01 Boiling water Reactor Experiment–1 Burial Grounds Engineered Barriers*, DOE/ID-10591, Parsons Infrastructure and Technology Group, Inc.

Parsons, January 8, 1996, *Remedial Action report for Radiologically Contaminated Soils Removal Action Project, Task Order 21, Operable Unit 10–6*, Subcontract Number C95-175008, Parsons Engineering Science, Inc.